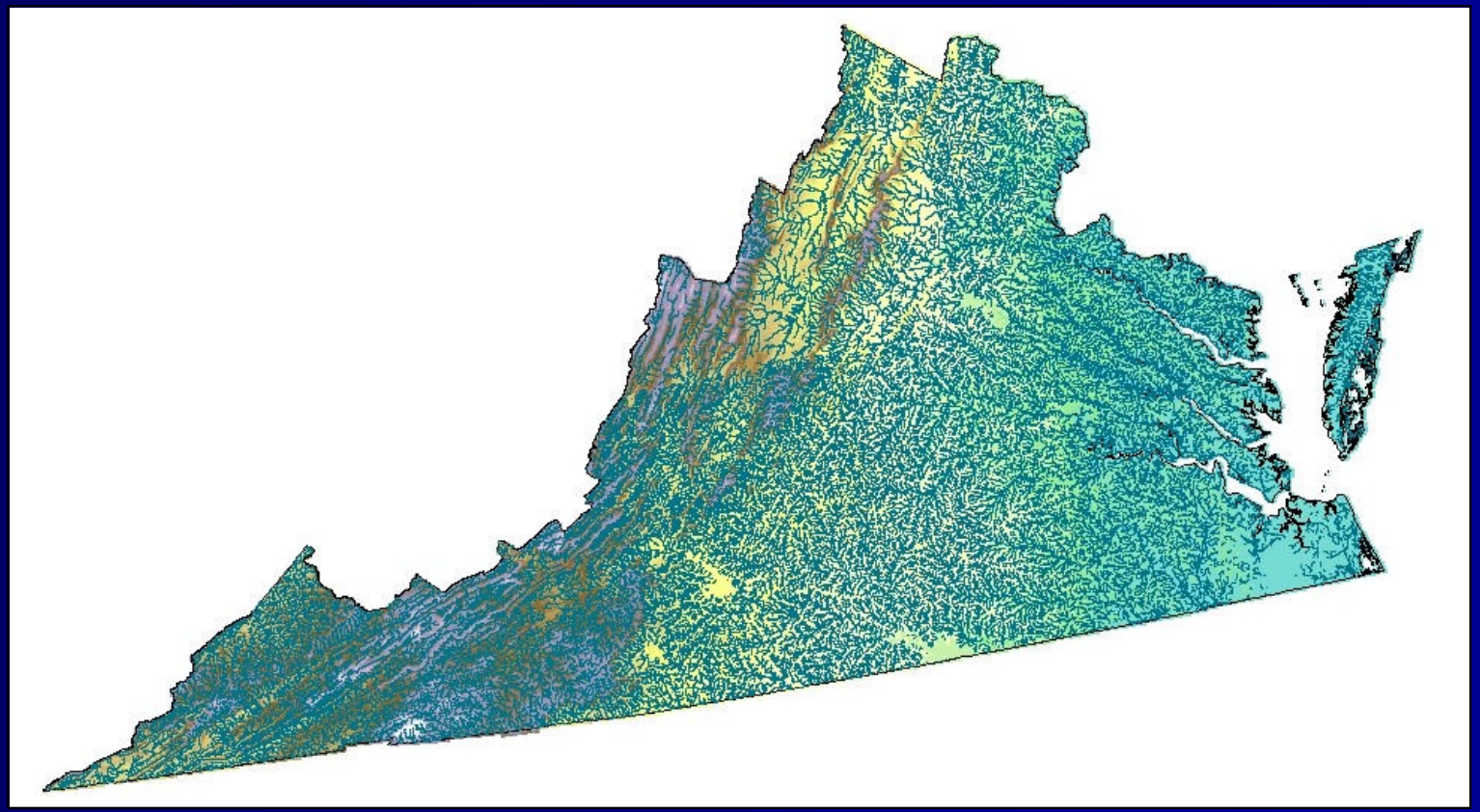
DEQ's Freshwater Probabilistic Monitoring (ProbMon) Program

DEQ
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

Presentation Goals

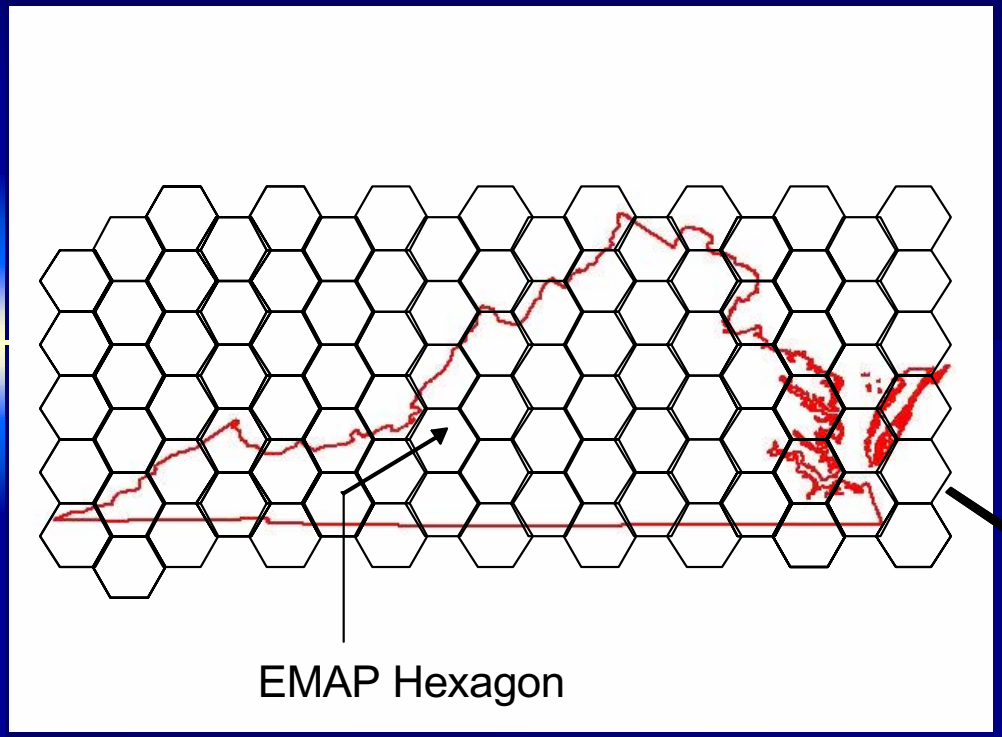
- Increase General Understanding of Virginia's Probabilistic Monitoring Program
  - Discuss Survey Design
  - Discuss What Probmon Data Represents
  - Discuss Data Collected
  - Discuss Uses of ProbMon Data (Case Studies)
  - Discuss Benefits and Future Goals

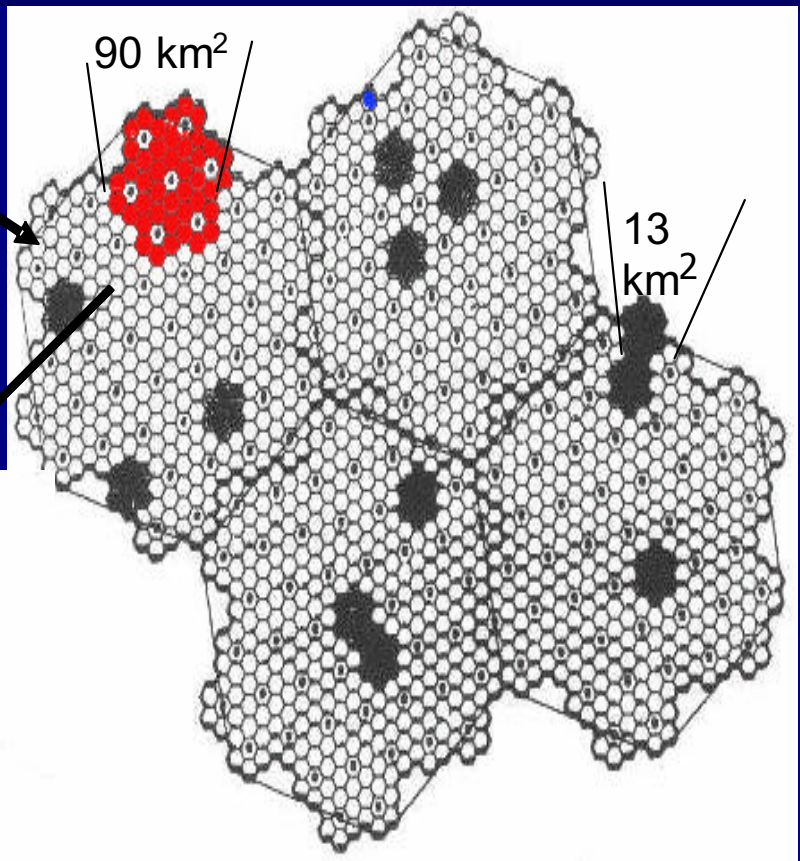
Virginia's Water Resources



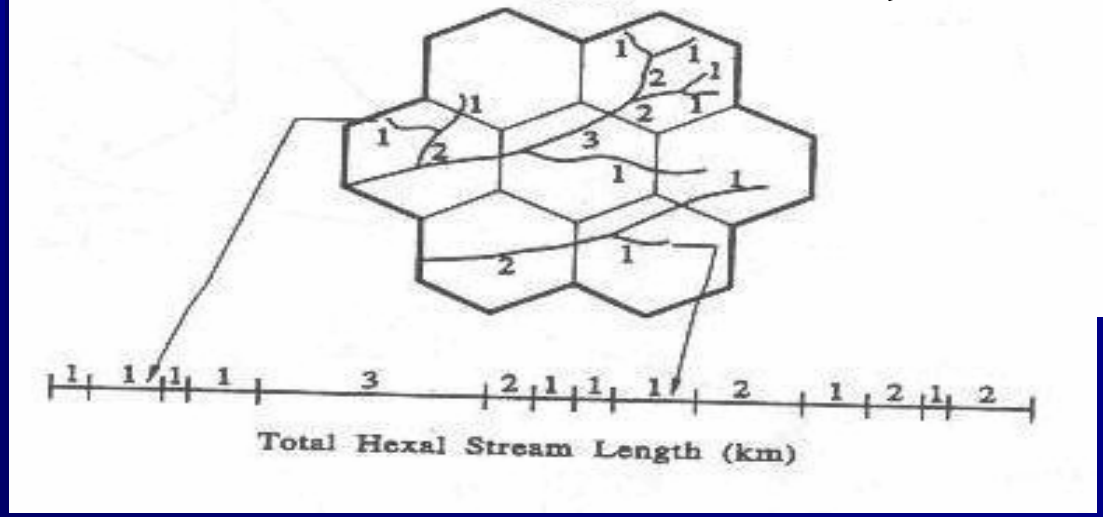
- Target population perennial freshwater river and streams
- NHD circa 1999 sample frame is 49,142 miles

Site Selection





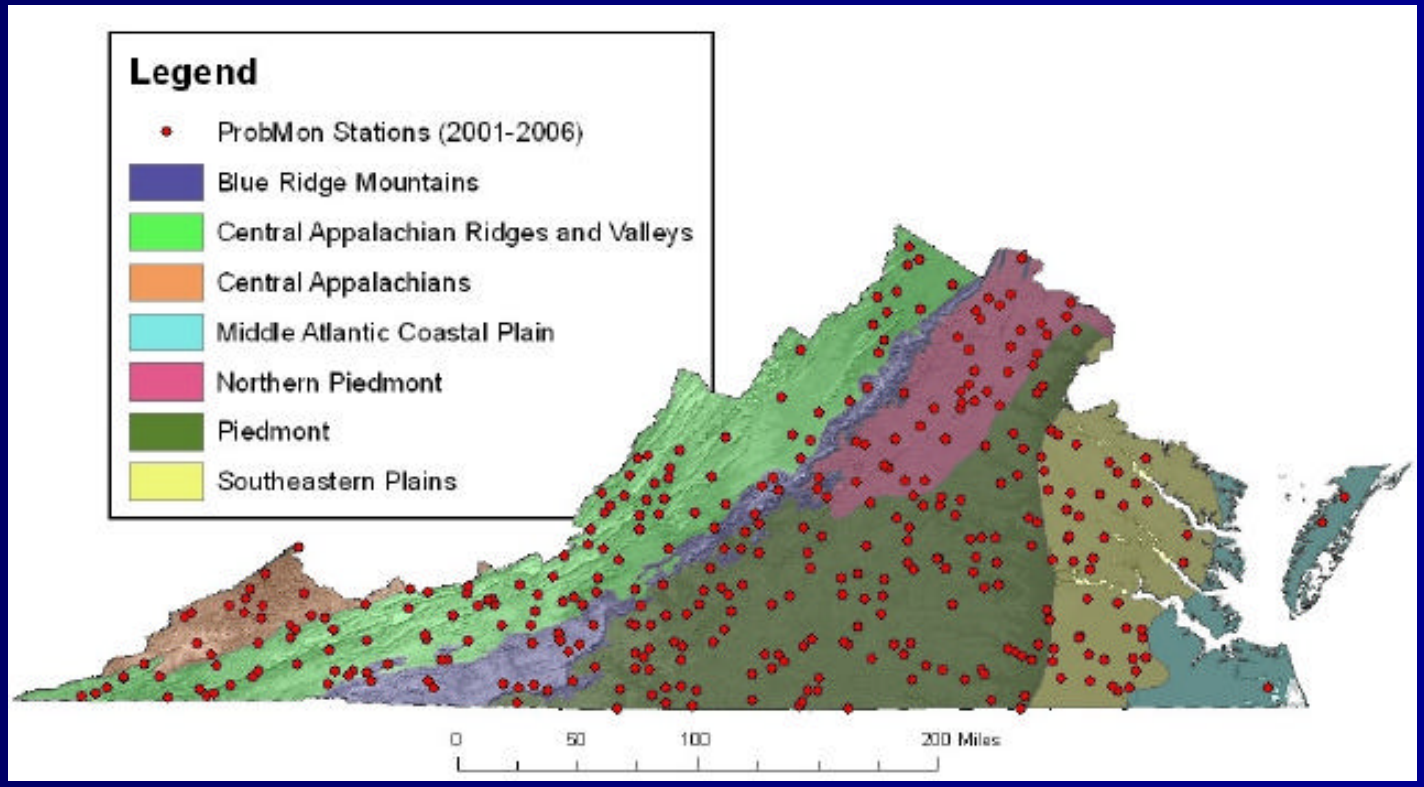
13 km^2 Hexagon



Data Collected

- Field data
  - DO, Temp, pH, Specific Conductance
- Benthic community metrics
  - CPMI/VSCI
- Habitat Survey
  - RBP & RBS
- Bacteria Indicators
  - Fecal Coliform & E. Coli
- Chlorophyll (water column)
- Total Organic Carbon
- Land Cover Data (GIS)
- Nutrients
- Solids
- Hardness
- Alkalinity
- Turbidity
- Chlorides
- Sulfates
- Heavy Metals & Pesticides (in sediment)
- Dissolved Metals (in water column)
- SPMDs
- Fish and Algae community (new for phase 2)

2001-2006 Sample Sites



- 15% sample frame is non-perennial, tidal, or reservoir
- Most parameters collected are known with +/- 5% CI

Hydrologic Conditions

(Tiffany Severs, Jackie Carl and Michael Hutchison)

	Spring ProbMon (n=349)	Fall ProbMon (n=285)
Rising Limb	57	36
Stable	267	219
Falling Limb	25	30
8% fall samples validated by field collection (r2=0.93)		

Hydrologic Condition	Percentile	Spring ProbMon Data Collection
Low Flow	<10	2.4
Below Normal	10 to 24	7.2
Normal	25 to 74	57.8
Above Normal	75 to 89	23.3
High Flow	> 90	9.3

Hydrologic Condition	Percentile	Fall ProbMon Data Collection
Low Flow	<10	25.0
Below Normal	10 to 24	22.0
Normal	25 to 74	44.0
Above Normal	75 to 89	7.7
High Flow	> 90	1.3

Case Studies

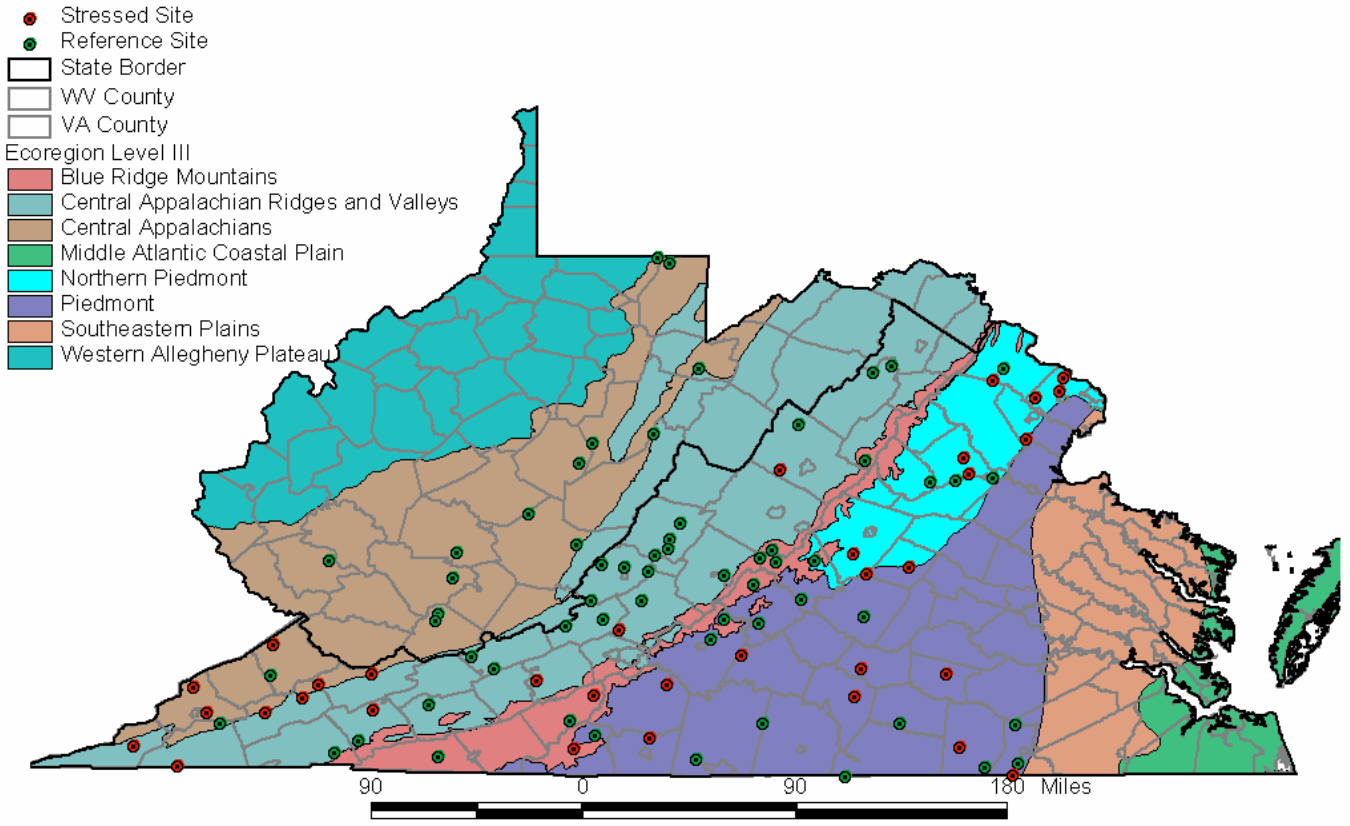
- Biomonitoring validation study
- Report condition of 100% stream miles
- Innovative monitoring technology (support TMDL studies)
- Identify water quality stressors
- Track watershed management decisions

Biomonitoring Validation

- 2001 biological index development for non-coastal Virginia begins (8 core metrics)
- Final report submitted in September 2003
- VDEQ concerned with data used to develop the Virginia Stream Condition Index (VSCI)
  - Lack of watershed size diversity
  - Bias toward mountainous ecoregions
  - Multiple samples at the same location

Biomonitoring Validation

New reference stations (n=104 total samples)



Mountain (n=71), Piedmont (n=33)

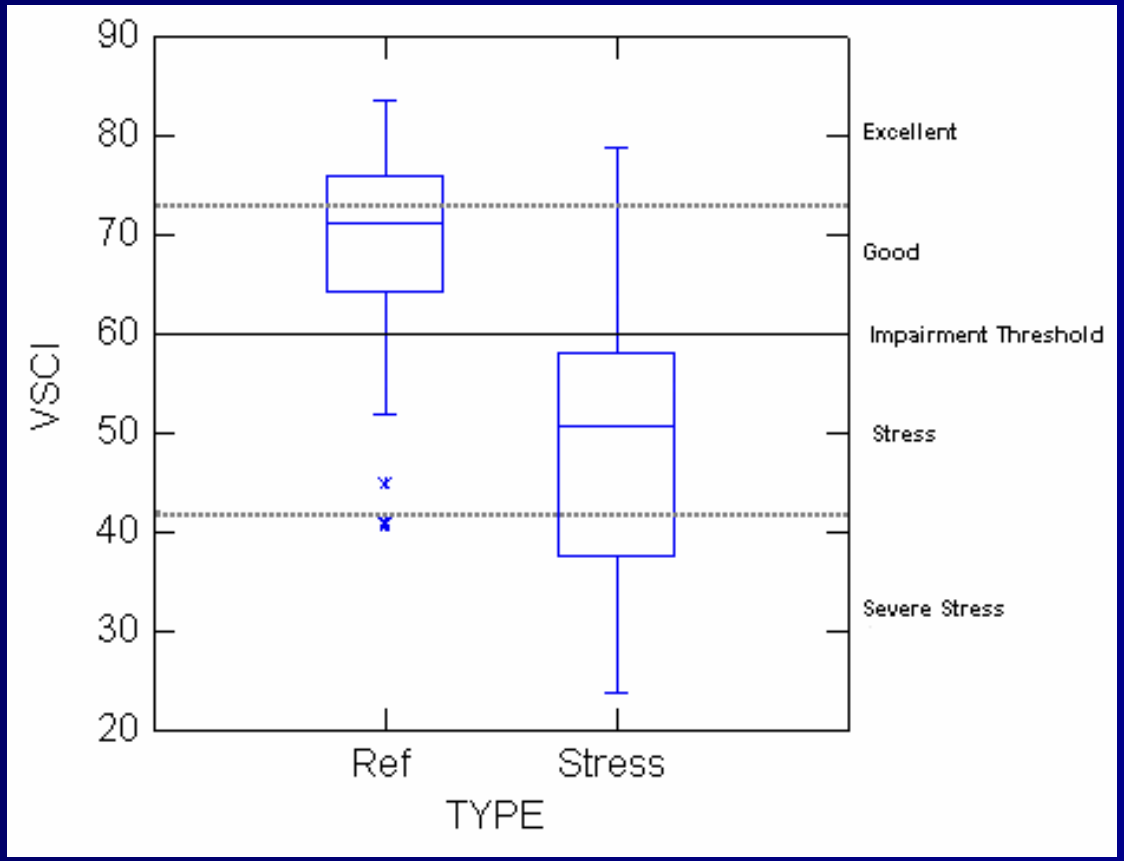
Biomonitoring Validation

Categories: season, basin size, ecoregion, bioregion, basin size, VDEQ region, river basin

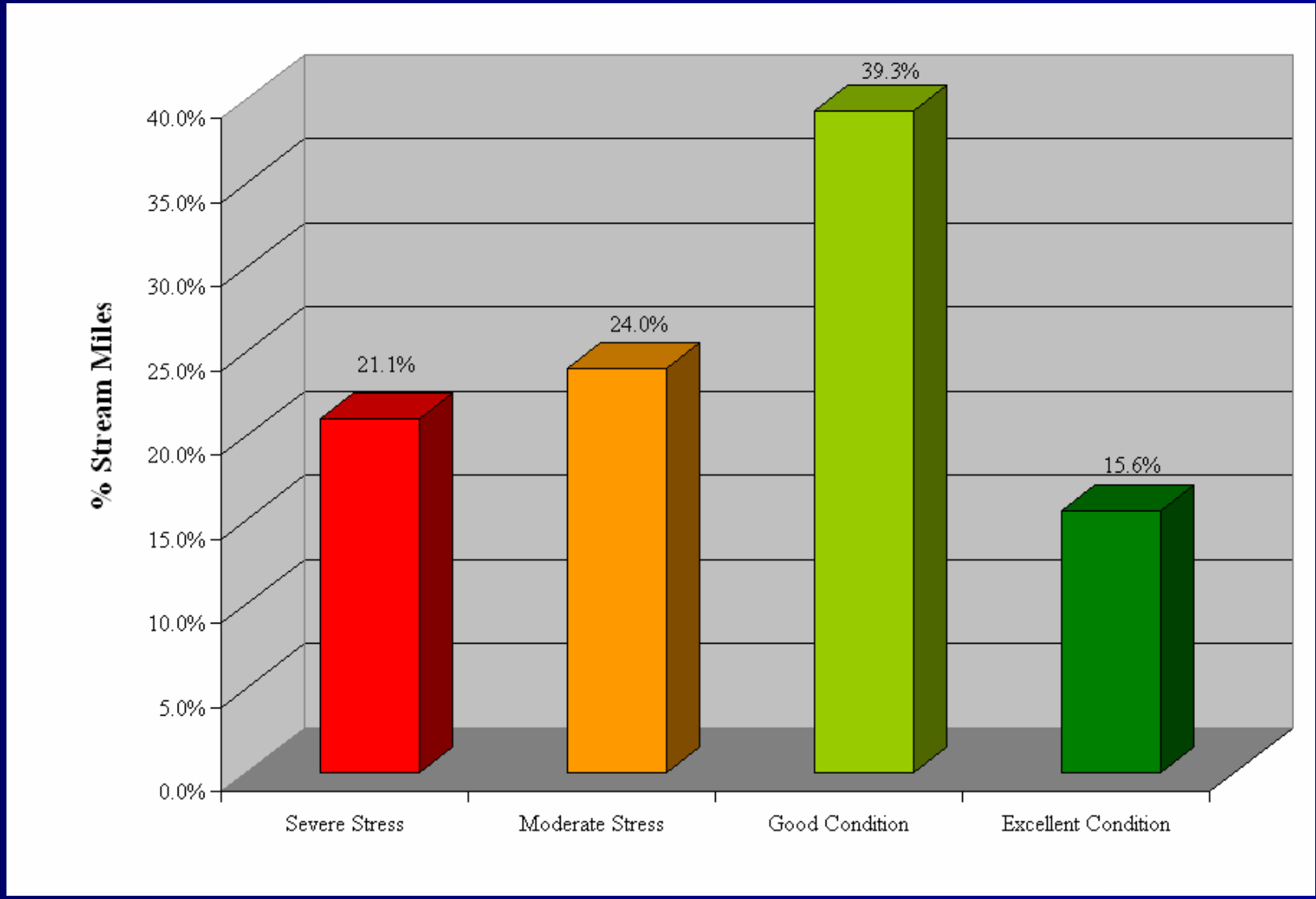
- Test for patterns in reference taxa
- Test for statistical significance
- Test for environmental significance
- Best standard value calibration

Biomonitoring Validation

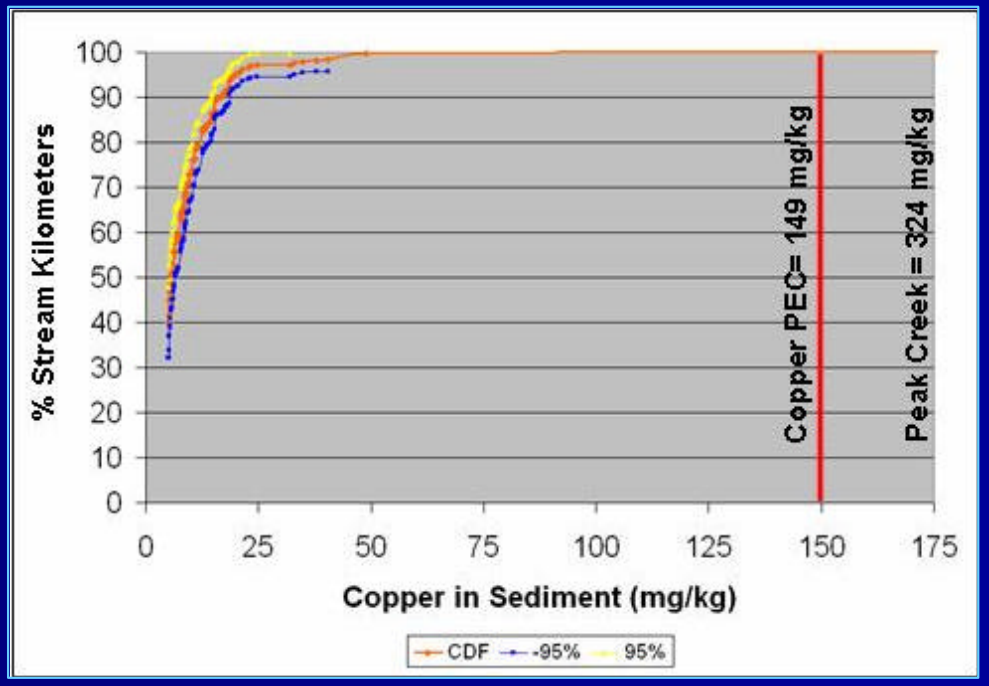
- VSCI works!
- http://www.deq.virginia.gov/probmon/pdf/scival.pdf



Report 100% Stream miles



Support TMDL Development



- Peak Creek (Metal TMDL)
- UT Chickahominy (Nutrient TMDL)
- Straight Creek (Ionic Strength TMDL)

Innovative Monitoring

THE IMPACT OF SEDIMENT ON BENTHIC HABITATS ...

In a healthy stream, spaces between rocks provide habitat for benthos ...

As fine sediment begins to accumulate, this habitat is reduced ...

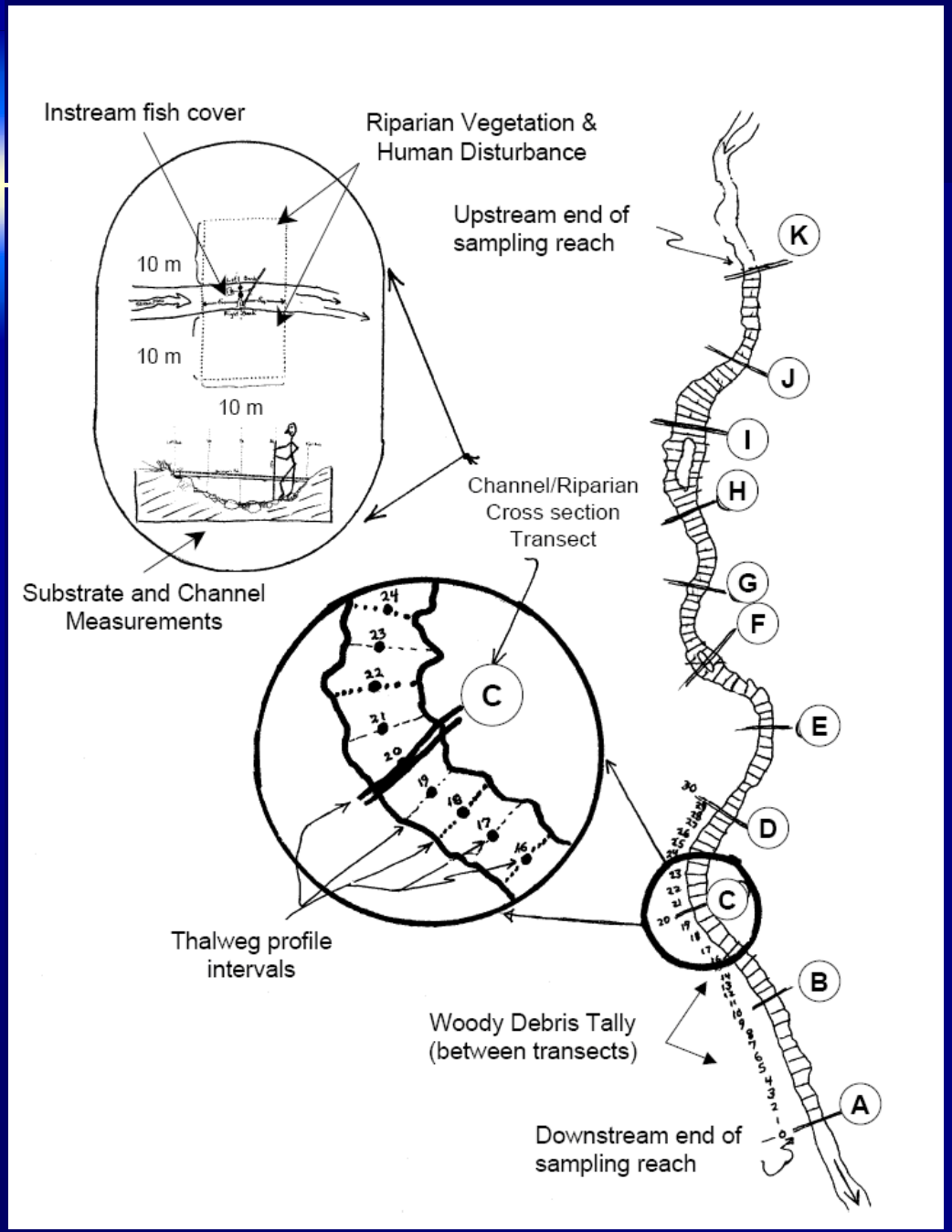
Interstitial spaces are beginning to fill in ...

Benthic habitat completely fills in as fine sediment settles out.

Graphics by Day Willis

Sedimentation is one of the most prevalent impacts to benthic communities. Excess sediment fills interstitial spaces in between stream substrates used by aquatic organisms for habitat. Until recently, tools for rapidly quantifying sedimentation impacts in streams have been inadequate. Methods existed for describing dominant particle size, but it was difficult to differentiate between natural conditions and anthropogenic problems. Virginia has a variety of stream types; many are naturally sand/silt bed streams, so simply measuring the size of the sediment particles cannot differentiate natural and human-influenced sediment load.

Relative Bed Stability (RBS)

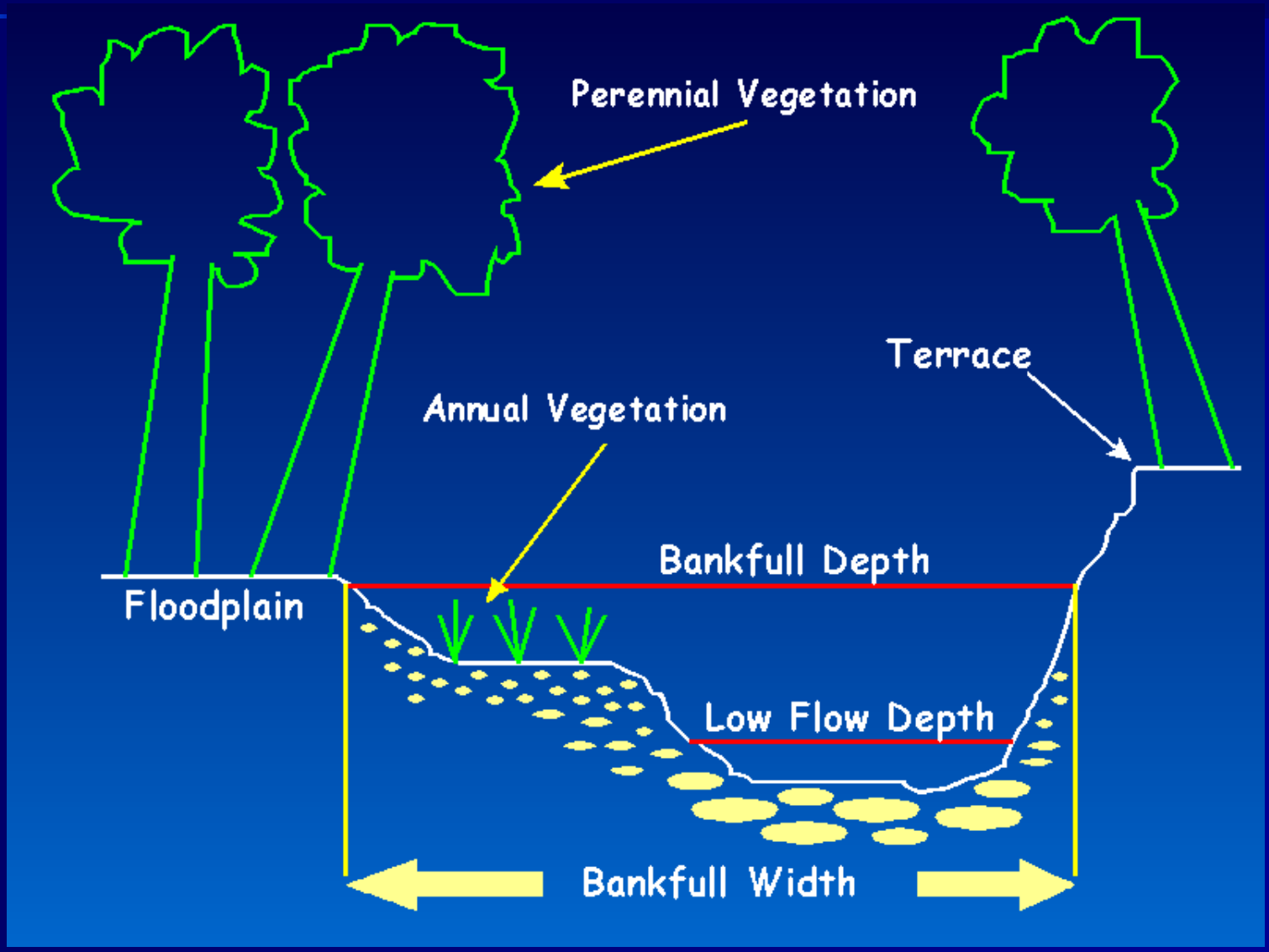


$$LRBS = \frac{\text{Avg. Particle Size}}{\text{Stream Power}}$$

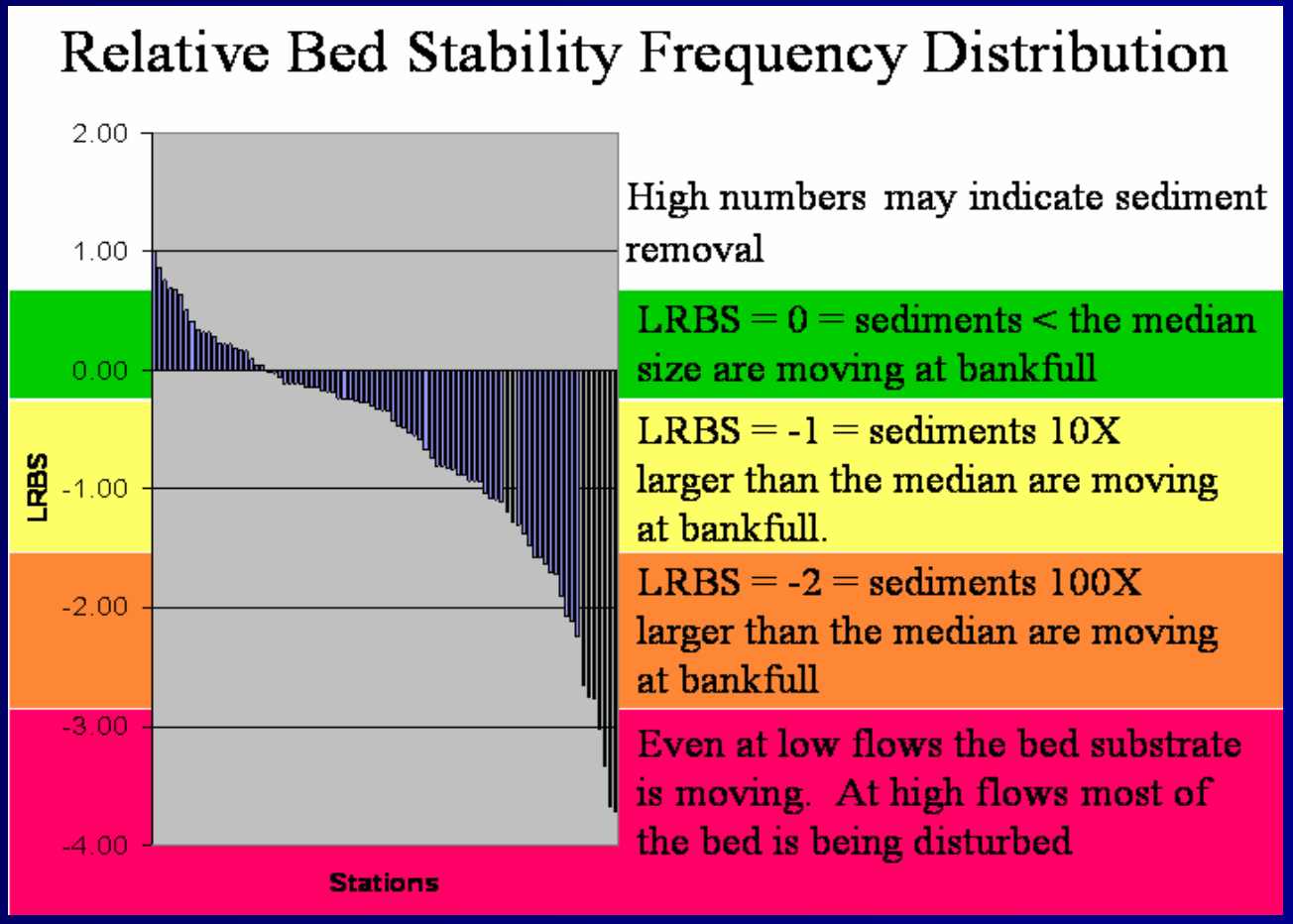
Avg. particles size comes from actual field measures

Stream power is what avg particle size should be carried in the stream based on slope and bankfull stream geometry

Relative Bed Stability (RBS)

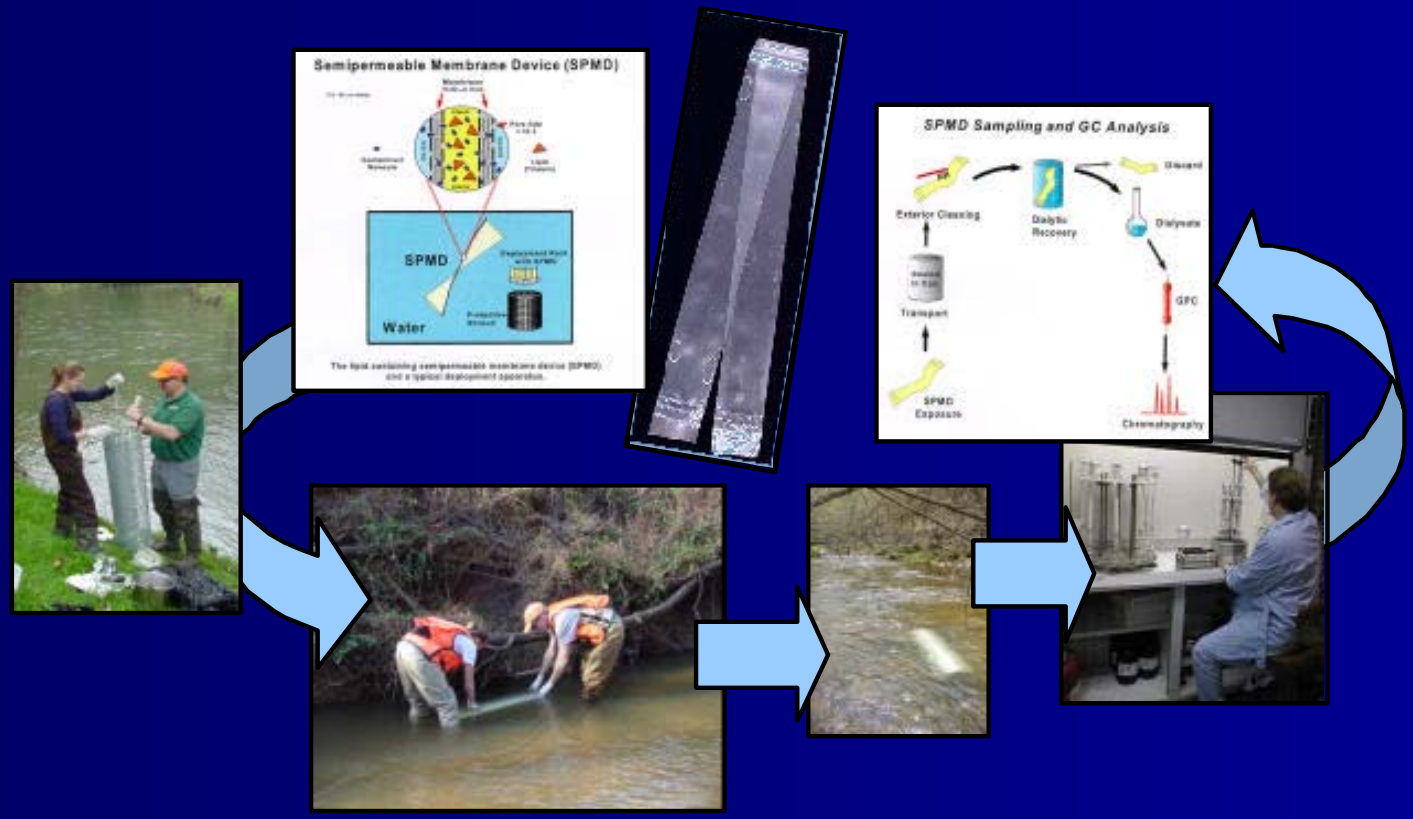


Innovative Monitoring



- Sediment endpoint in many biological studies
- Relative bed stability=quantitative habitat data

Innovative Monitoring



- Semi-permeable membrane device (virtual fish)
- Determine water column concentration

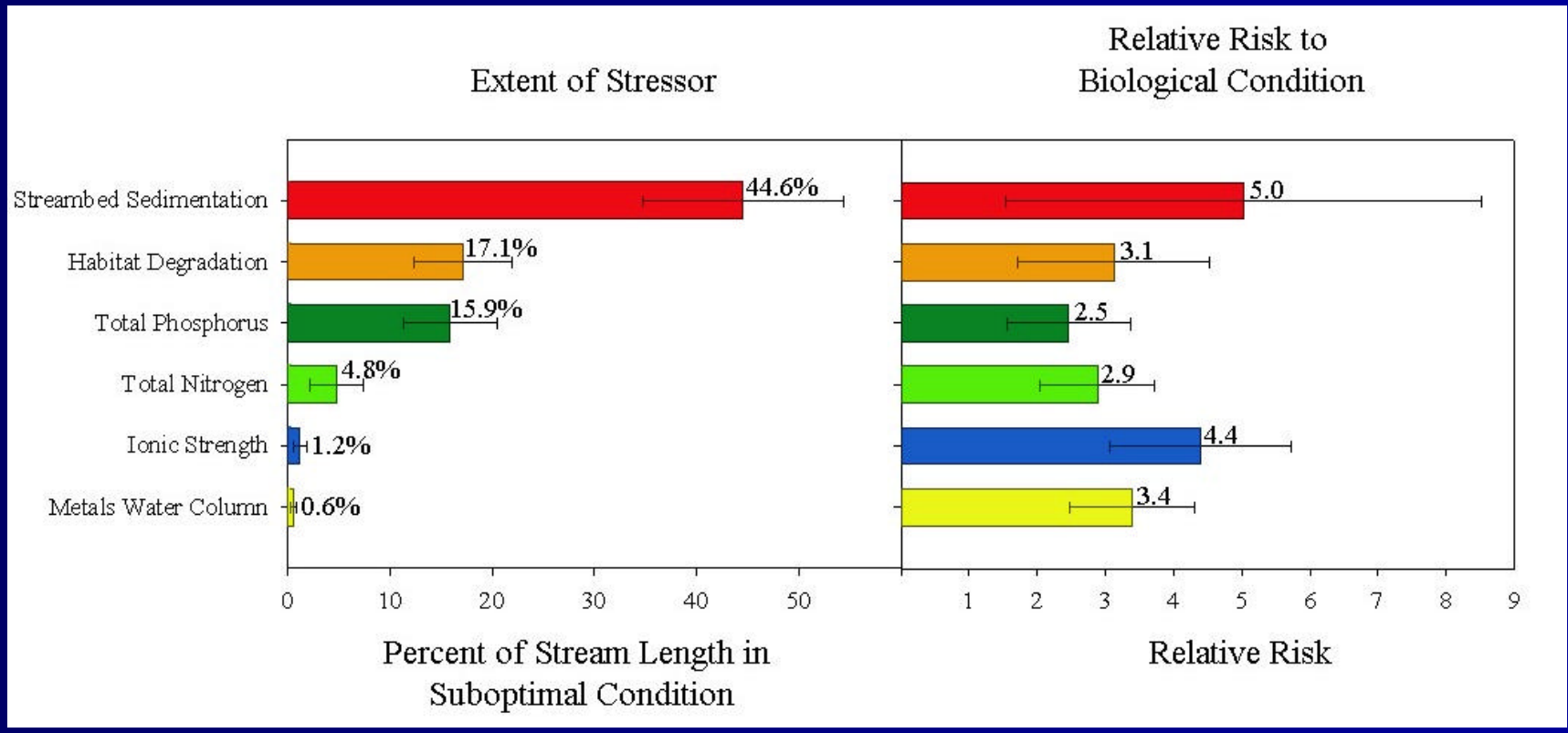
Water Quality Stressors

Response Parameters	Optimal	Suboptimal	Classification Reference
Virginia Stream Condition Index	>60	<50	(VDEQ 2007)
Coastal Plain Macroinvertebrate Index	>16	<16	(VDEQ 2007)

Stressor Parameters	Optimal	Suboptimal	Classification Reference
Total Nitrogen (mg/L)	<1	>2	(VDEQa 2006)
Total Phosphorus (mg/L)	<0.02	>0.05	(VDEQa 2006)
Habitat Degradation (unitless)	>150	<120	(USEPA 1999)
Streambed Sedimentation (unitless)	>-0.3	<-1.0	(Kaufmann 1999)
Ionic Strength (TDS mg/L)	<100	>350	(VDEQb 2006b)
Metals Water Column (unitless)	<1	>2	(Clements 2000)

- Relative Risk Calculations
- Borrowed terminology from the medical field
- Report RR greater than 1 (CI included)

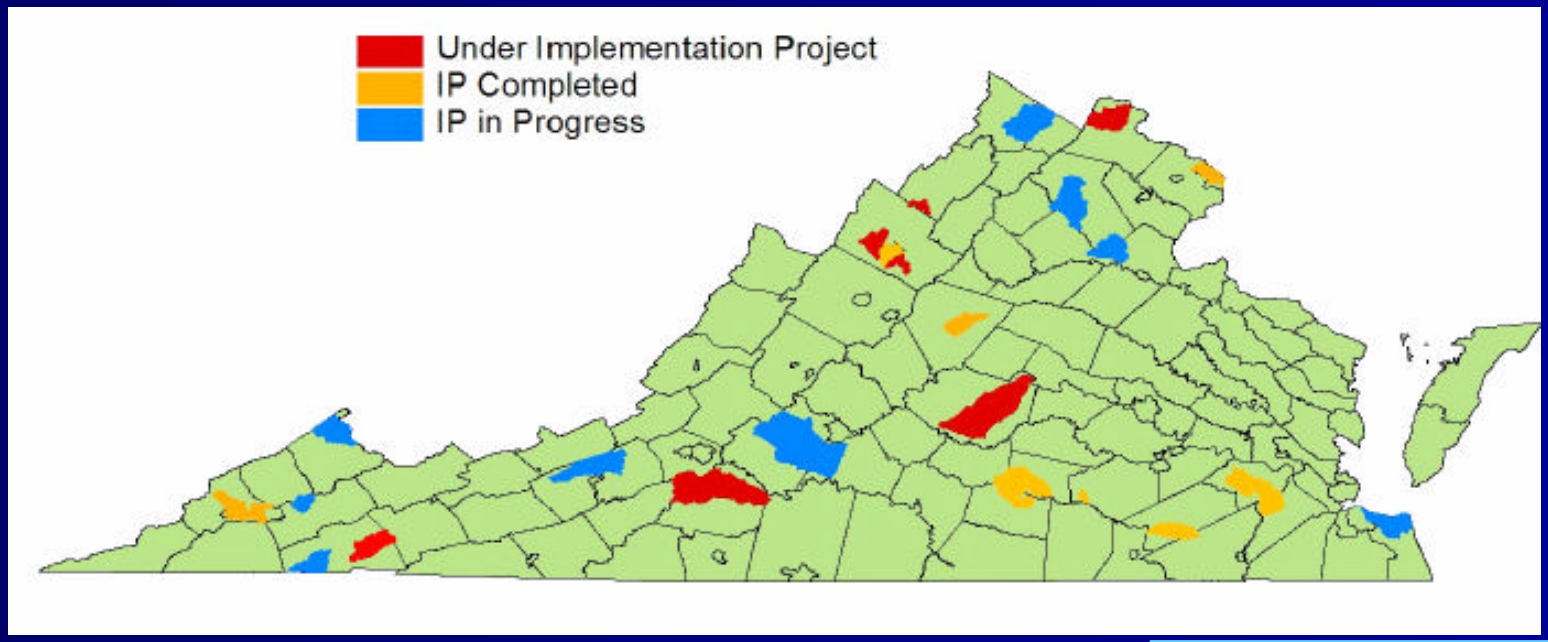
Water Quality Stressors

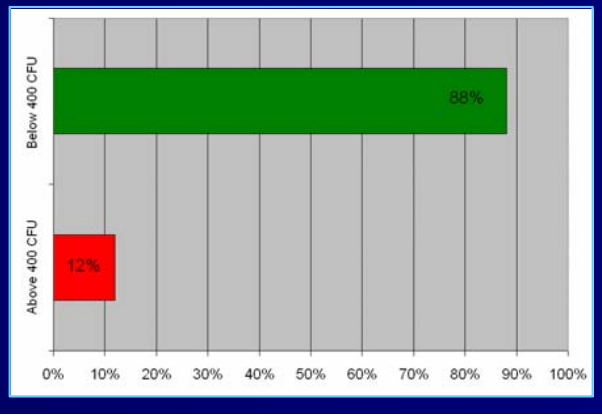


$$RR = \frac{\Pr(\text{Poor VSCI/CPMI, given poor sediment condition})}{\Pr(\text{Poor VSCI/CPMI, given good sediment condition})}$$

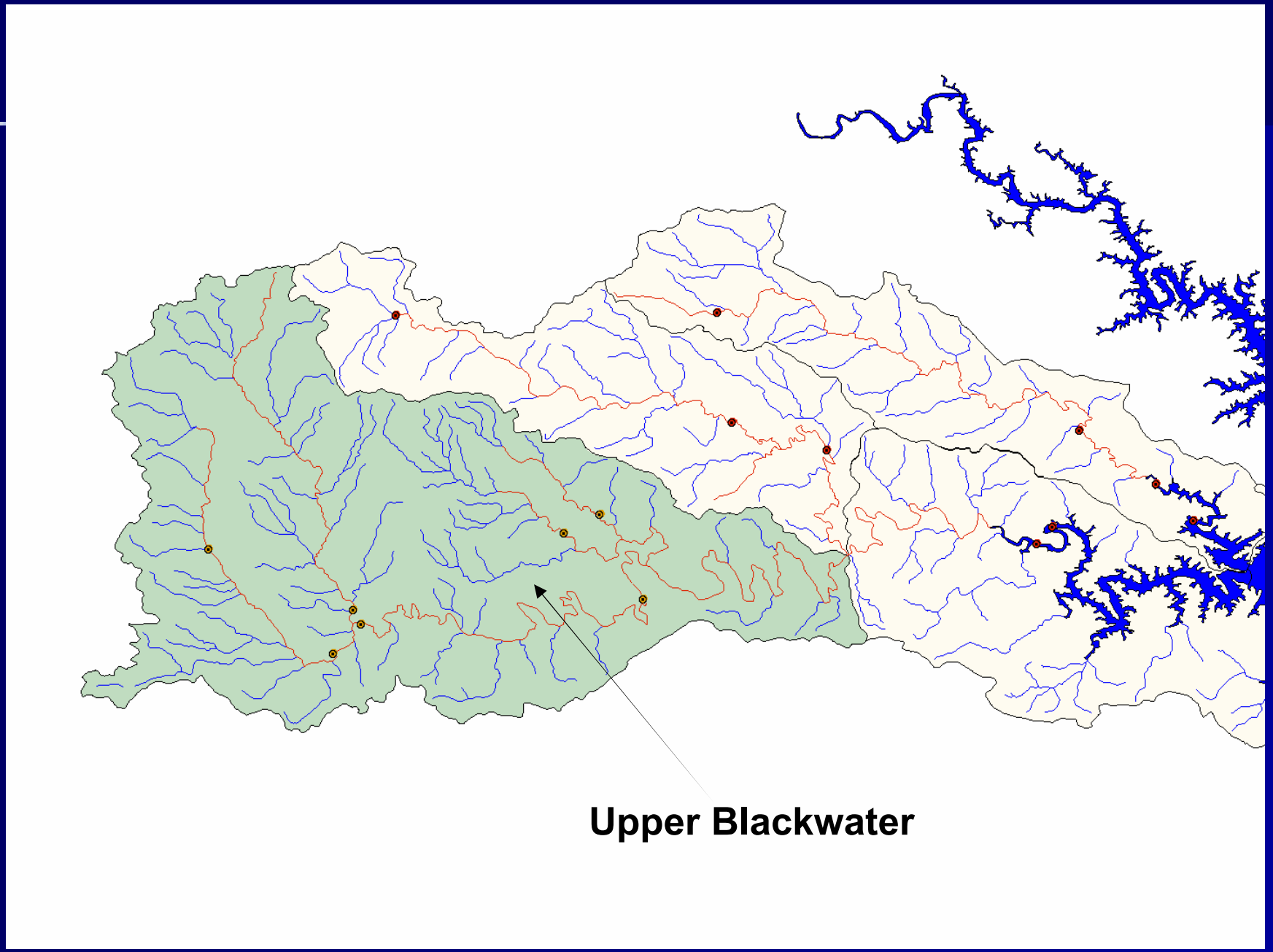
Tracking Watershed Management

Virginia has 8 Implementation Plans in progress



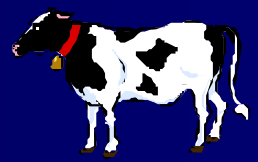


Targeted Monitoring



Livestock Excluded

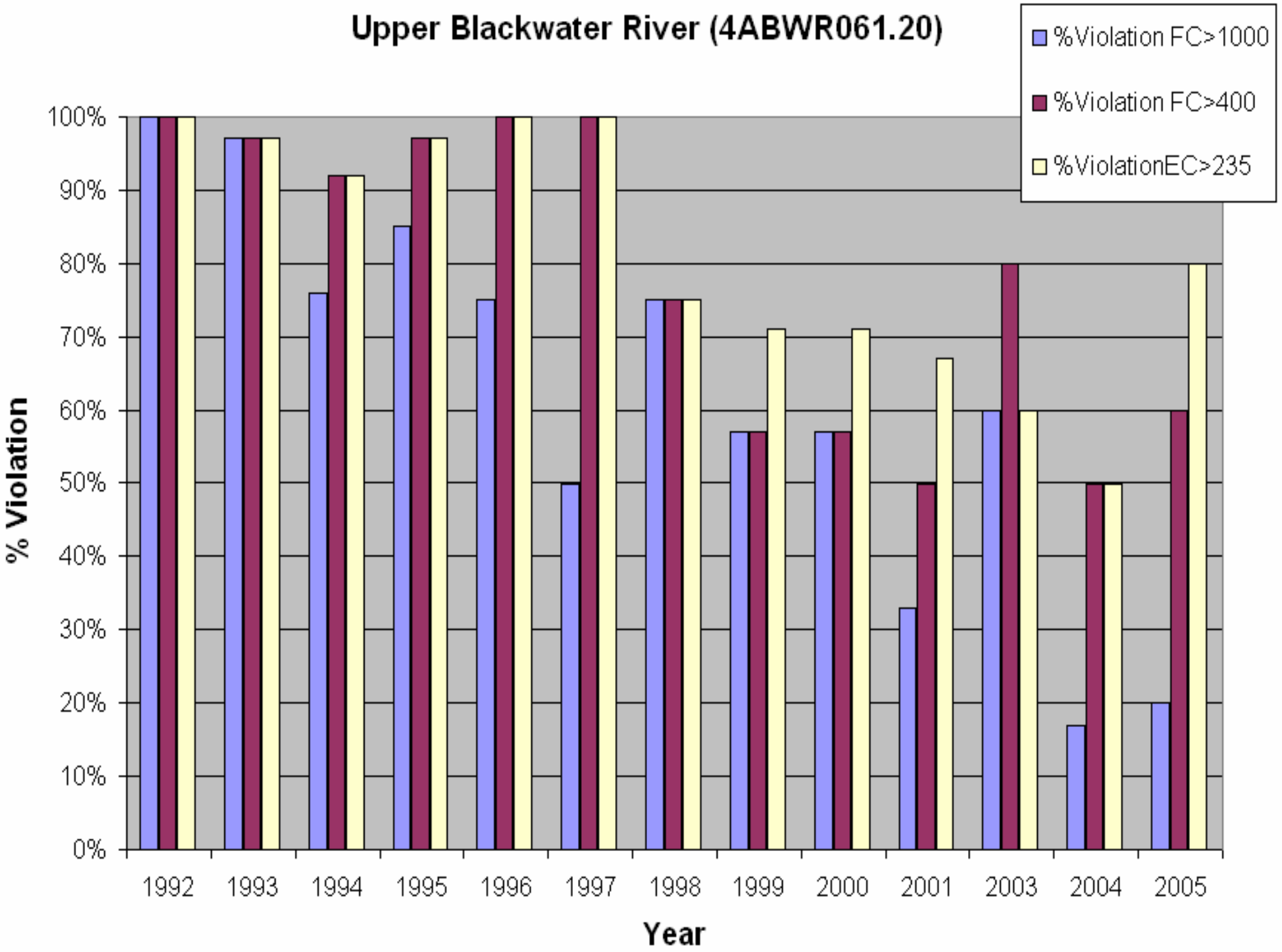
- MF Holston R. (2010)
- North R. (1500)
- Blackwater R. (2040)
- Catoctin Cr. (50)
- Holmans Cr.* (260)
- Willis R. (205)



= 200 livestock excluded

Total = 6,065

*Estimated


Upper Blackwater River (4ABWR061.20)
%Violation FC>1000
%Violation FC>400
%ViolationEC>235
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
% Violation
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2003
2004
2005
Year

Summary of Benefits of ProbMon

- Biomonitoring
  - Doubled the number of reference sites
  - Validated VSCI (new biomonitoring tool)
  - Identification of stressor(s)
- New Technologies
  - Relative bed stability
  - Virtual fish
- Assessments
  - Statistical confidence of hundreds of water quality parameters
  - Set baseline for ecological/chemical trend analysis
- Research
  - Provides design for testing new methods
  - Monitoring strategy allowed VDEQ to obtain grant money
- Community
  - Provide summaries to the public
  - Partnerships (DGIF, EPA, USGS, VT, VCU)

Acknowledgements

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Questions?

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